SPACED REPETITION QUESTIONS Worksheet number: \_\_\_\_\_\_\_\_\_\_\_

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| **Schedule Spacing (round up and approximate)** | | | | |  | **Question 1:** | *Today ( DD / MM )* | **Question 2:** | *(Days x 0.03)* |
| **A.** How many months until you begin revision?  *One month before the exam* | | | |  |  | **Question 3:** | *(Days x 0.10)* | **Question 4:** | *(Days x 0.23)* |
| **B.** This is | *(x4.3)* | weeks. **C.** | *(x7)* | days. |  | **Question 5:** | *(Days x 0.48)* | *Estimate the approximate date and write it in the box above using the formula provided* |  |

*Record the date in your diary, planner or calendar.*

**Isotopes:**

1. Determine the molecular weight of the following mixtures of isotopes
   1. 75% chlorine-35 and 25% chlorine-37
   2. 20% germanium-70, 27% germanium-71, 8% germanium-72, 37% germanium-73, and 8% germanium-74

**The ideal gas law and molecular formulas:**

1. A sample of phosphorus with a mass of 10.46 mg has been entirely vaporized by heating it to a temperature of 575 °C in a sealed flask with a volume of 18.08 cm3. The pressure in the flask was measured to be 32.86 kPa. Assuming ideal gas behaviour, determine the molecular formula of phosphorus at these conditions.

**Reactions of the hydroxides and carbonates with water and dilute acids:**

1. Gastric acid is mostly dilute hydrochloric acid, so the pH in the stomach is quite low, varying from around 1 to about 4.5. We would expect such an acidic environment to be corrosive, but this isn’t usually the case, because the stomach is lined with a protective mucosal surface. Occasionally though, it does happen that more gastric acid is produced than is necessary for digestion, causing us to experience increased sensitivity in the stomach, commonly called indigestion. Sometimes, it also happens that some stomach acid travels back up the oesophagus, which isn’t designed to handle such a low pH, causing another discomfort, known as heartburn.

In cases like these, if the discomfort is an occasional occurrence, we usually take an antacid to relieve heartburn or the symptoms of hyperacidity. Antacids work by neutralizing this unwanted, or excess gastric acid. One of the most common components of antacids is magnesium hydroxide, but there are also brands that contain calcium carbonate or magnesium carbonate.

1. Write a balanced equation, including state symbols for the neutralization reactions by which magnesium hydroxide, calcium carbonate and magnesium carbonate balance the pH in the stomach
2. Mg(OH)2 is one of the most common components of antacids, but the hydroxides of calcium and barium are never used. Why do you think that is?
3. Can you guess one advantage of using Mg(OH)2 over CaCO3 and MgCO3?

**Reactions of alcohols:**

4.

I. Draw the structures of the product(s) of the following transformations.

1. 
2. 
3. 
4. As you observe the above reaction, the relative ease with which alcohols undergo dehydration is in the following order:  
     
   IIIry alcohol > IIry alcohol > Iry alcohol  
     
   Explain the above behaviour.

***(Stretch and challenge – Beyond AS)***

II. Rank the following alcohols in order of increasing ease of acid catalyzed dehydration.



III. Draw the mechanism for the following reaction.



**Determining the equilibrium constant from initial amounts and the amount of used up reactant:**

1. Ammonia can be produced by the reaction between hydrogen and nitrogen gas, represented by the equation:



Unfortunately though, the equilibrium of this reaction is not very favorable for getting a good yield. If we place 4.00 mol of nitrogen gas and 4.00 mol of hydrogen gas in a sealed flask with a volume of 5.00 dm3, at a temperature of 500ºC, only 0.20 mol of nitrogen gas will have been used up when equilibrium is established. What is the equilibrium constant for the production of ammonia from nitrogen and hydrogen at 500ºC? (Give the answer to three significant figures.)

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a) 35.50

b) 71.86

1. As we have a molecule that only contains phosphorus atoms, the molecular formula will be , and we need to determine x. For this purpose, we first need to determine the molar mass of the phosphorus molecule at these conditions:

and . Therefore:







Now, we can determine x:



So, the molecular formula of phosphorus at these conditions is P4.

* + 1. Mg(OH)2(s) + 2HCl(aq)  MgCl2(aq) + 2H2O(l)
    2. CaCO3(s) + 2HCl(aq)  CaCl2(aq) + H2O(l) + CO2(g)
    3. MgCO3(s) + 2HCl(aq)  MgCl2(aq) + H2O(l) + CO2(g)
  1. The strength and the solubility of the hydroxides of the group 2 metals increase as we go down the group, and so their solutions are more alkaline. So, if we used Ca(OH)2, or Ba(OH)2, more of the hydroxide would dissolve, more hydroxide ions become available, making the environment in the stomach more alkaline compared to when Mg(OH)2 is used. This would interfere with the normal functioning of the stomach, and cause damage to the tissue.

Another thing is that, since Mg(OH)2 isn’t very soluble, excess Mg(OH)2 passes through the system without being absorbed. On the other hand Ca(OH)2 is more soluble in water, so it dissolves and dissociates in the stomach.

* 1. When a carbonate is used, some carbon dioxide gas is released, and this can cause further discomfort, bloating and belching. In order to avoid this, antifoaming agents have to be added to the antacid.

2. 
3. 
4. 
5. In the dehydration of the alcohols the slowest step is the formation of the carbocation from the alcohol (the rate determining step).   
   This is the step that determines the overall reactivity of alcohols towards dehydration. The stability of carbonations changes according to the following order.

IIIry > IIry > Iry



The formation of a tertiary carbocation is easiest because the positive charge is most effectively stabilized in a tertiary carbocation, because three alkyl groups are present (vice-versa for a primary carbocation). So the ease of dehydration changes as per the above order.

II. b > c > a

III.



1. The equation for this reaction is:



Using the expression in eq. 1, we can write the equilibrium constant in the following way:



But, we don’t know the equilibrium concentrations. We could determine the equilibrium concentrations from the amount of each substance at equilibrium, but we don’t have that information either. So, in order to determine the value of the equilibrium constant for the reaction between nitrogen and hydrogen at 500ºC from the information given in the exercise, let’s first write out what we know, and which values we need to determine in order to able to calculate Kc.

First of all, we know that at the start of the reaction we had 4.00 mol N2 and 4.00 mol H2, and no ammonia was present in the reaction system. We also know that 0.20 mol N2 were used up in the reaction, and we know that the volume of the flask is 5.00 dm3. So, we can write:



 





Where we use  to denote the amount present at the start of the reaction and  to denote the amount that was used up during the reaction. Using this information and relating it with the stoichiometry of the reaction, we can determine the other values that we need in order to calculate the value of the equilibrium constant.

From the equation of the reaction, we can see that we use up three moles of hydrogen for every mole of nitrogen. So, we have:



We also know that for every mole of nitrogen we get two moles of ammonia. So, we can determine the amount of ammonia that was generated during the reaction:



So, now we have:



 

 

 

With this information, we can determine the amounts of nitrogen, hydrogen and ammonia at equilibrium. In order to determine the amount of the reactants at equilibrium, we subtract the amount that was used up during the reaction, from the amount that was already present there at the beginning. For the products, we add the amount that was produced during the reaction to the amount that was already there before the start of the reaction:







So, now we have:



  

  

  

Now that we have the amount of each of the participants in the reaction at equilibrium, we can determine their equilibrium concentrations:







Once we have the equilibrium concentrations of the participants in the reaction, we can simply substitute them in the expression for the equilibrium constant that we derived under (a):



Simplifying this expression we get:



And now, to get the result with two significant figures:

